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Kenneth Q. Lao  
Ware, Fressola, Van der Sluys & Adolphson LLP  
755 Main Street Bldg.5  
P.O. Box 224  
Monroe, CT 06468

EXAMINER

WILLE, DOUGLAS A

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 07/11/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application N .

09/319,699

Examiner

Douglas A Wille

Applicant(s)

LIPPERT ET AL.

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 05 May 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 23-43 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 23-43 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Claim Rejections - 35 USC § 112*

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 23, 24 and 43 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claims 23 and 24 show a Si/SiGe/Si bipolar device where C is provided in any of the base, emitter or collector up to a concentration of  $10^{21}\text{cm}^{-3}$  and the lattice change is less than  $5(10)^3$ . However, if C is added to Si with a concentration at the upper limit the lattice will change by more than the claimed amount and thus the claimed range is not enabled.

### *Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 23 - 25 and 29 - 34, 40, and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lanzerotti et al. (IEEE) in view of Lanzerotti et al. (IEDM).
5. With respect to claims 23, 24 to the extent that such a lattice change is possible, 25 and 29, Lanzerotti et al. (IEEE) show a bipolar transistor (see page 334 column 2) with a Si emitter, a SiGe base with C added at a concentration of 0.011 and a Si collector. C is added only to the

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base layer. Lanzerotti et al. (IEEE) show undoped spacers of SiGe on either side of the doped base layer to prevent diffusion of the dopant into the emitter or collector and thus the base is not in direct contact with the emitter and collector. Lanzerotti et al. (IEDM) shows that it is necessary to reduce the base resistance (page 249, column 1, first paragraph of the introduction) and that the addition of C reduces the diffusion of the B dopant. It would therefore be obvious to omit the undoped spacer layers to reduce the series resistance and then the base would be in direct contact with the emitter and the collector.

6. With respect to claims 30 and 31, Lanzerotti et al. (IEEE) show the Ge concentration as 0.25 (page 334, column 2, first full paragraph).

7. With respect to claim 32, Lanzerotti et al. (IEEE) show the base layer is 46 nm (page 334, column 2, first full paragraph).

8. With respect to claim 33, Lanzerotti et al. (IEEE) show the base layer as 46 nm but since criticality has not been established this is regarded as equivalent to 40 nm.

9. With respect to claim 34, Lanzerotti et al. (IEEE) show the product is 1250 which is within the claimed range.

10. With respect to claim 40, Lanzerotti et al. show the base is doped to  $7(10)^{19}$  (page 334, column 2, first full paragraph) which is within the claimed range.

11. With respect to claim 41, Lanzerotti et al. do not specify that the doping is uniform over the whole thickness but it would be obvious to make it uniform since a non-uniform profile would increase the resistance.

12. Claims 26 - 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lanzerotti et al. (IEEE) in view of Lanzerotti et al. (IEDM) and further in view of Shoji et al.

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13. With respect to claim 27, both Lanzerotti et al. references show the C as only being in the base but Shoji et al. show a bipolar transistor (Figure 2A and column 4, line 42 et seq.) where the C is in both the emitter and the base. The use of C minimizes the formation of misfit dislocations which reduces device performance (column 2, line 13 and column 1, line 55). It would have been obvious to modify the basic device to include the C in the other layer to minimize misfit dislocations.

14. With respect to claims 26 and 28, since it is effective to solve a problem with one interface, it would also be obvious to use the same solution for the other interface or both interfaces.

15. Claims 35 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lanzerotti et al. (IEEE) in view of Lanzerotti et al. (IEDM) and further in view of Sato et al.

16. With respect to claims 35 and 36, Sato et al. show that a conventional base would be 59 nm wide with a 9% Ge level which gives the product as 531. Since it is standard, it would be obvious to use it in the Lanzertotti et al. (IEEE/IEDM) device as a design alternative.

17. Claims 37 - 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lanzerotti et al. (IEEE) in view of Lanzerotti et al. (IEDM) and further in view of Sokolic et al.

18. Neither Lanzerotti et al. show the shape of the Ge distribution but Sokolic et al. show the distribution can be an arbitrary trapezoid or uniform (see page 263, third paragraph under Introduction). It would be obvious to use any of the shapes as a design alternative since they are known.

19. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lanzerotti et al. (IEEE) in view of Lanzerotti et al. (IEDM) and further in view of Li et al.

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20. Neither Lanzerotti et al. show detailed contact structures but Li et al. show the use of a T-shaped emitter contact of doped poly (column 5, line 10) which permits a narrow emitter contact while providing a large contact area (column 3, line 54). It would have been obvious to use the T-shaped contact to provide large contact area as shown by Li et al. to provide ease of contacting.

***Response to Arguments***

21. Applicant's arguments filed 5/5/03 have been fully considered but they are not persuasive.

22. With respect to the 112 rejection, Applicant states that it is not possible to infer the strain and that the strain and the C concentration are independent. First, it is possible to infer the strain and Applicant is referred to Vigard's law. Second, whether the two are claimed as independent features or not, they are still bound together by the physics of the crystal. Applicant also claims that the C can be interstitial and refers to Osten et al. but note first, that Lanzerotti et al. (IEEE) shows that in SiGeC the C is substitutional (page 335, column 1, line 3) and since the whole point of adding C is to reduce strain, it must be substitutional. Also note that Osten et al. refers to SiC.

23. Applicant states that the Lanzerotti et al. references do not suggest omitting the spacer layers but note that Lanzerotti et al. (IEDM) shows the importance of low base resistance (page 249, 1<sup>st</sup> paragraph under Introduction) and that the use of undoped spacer layers has problems associated with their use (page 249, column 1, 3<sup>rd</sup> paragraph under Introduction). While the removal of spacer layers is not specifically stated, the implication is clear that their effect should be minimized and their removal is obvious. Applicant further states that Lanzerotti et al. (IEDM)

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shows that the spacer layers are used to prevent high  $I_B$  but note that the problem of high  $I_B$  is due to the diffusion of B from the base into the emitter and the use of C prevents such diffusion.

Applicant also states that Examiner concedes that the spacers prevent diffusion of B and therefore this shows that the spacers should not be omitted but see the argument just above.

24. Applicant states that the only reason to combine is hindsight but note again that Lanzerotti et al. (IEDM) shows the importance of reducing the base resistance.

25. In view of the new rejection for claims 37 – 39, Applicant's comments are moot.

### *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas A Wille whose telephone number is (703) 308-4949. The examiner can normally be reached on M-F (6:15-2:45).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



Douglas A. Wille  
Primary Examiner

July 1, 2003